The CRUSHED STONE JOURNAL

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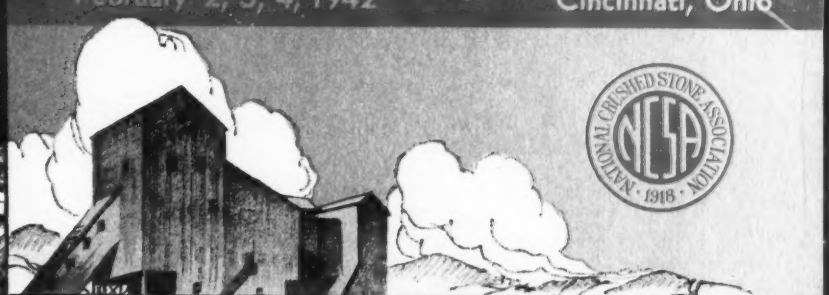
- What the Priorities System Is—and What It Is Not

SILVER ANNIVERSARY CONVENTION

February 2, 3, 4, 1942 • Cincinnati, Ohio



September—October • 1941

Official Publication
NATIONAL CRUSHED STONE ASSOCIATION

Technical Publications

of the

National Crushed Stone Association, Inc.

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BULLETIN No. 1

The Bulking of Sand and Its Effect on Concrete

BULLETIN No. 2

Low Cost Improvement of Earth Roads with Crushed Stone

BULLETIN No. 3

The Water-Ratio Specification for Concrete and Its Limitations

BULLETIN No. 4

"Retreading" Our Highways

BULLETIN No. 5

Reprint of "Comparative Tests of Crushed Stone and Gravel Concrete in New Jersey" with Discussion

BULLETIN No. 6

The Bituminous Macadam Pavement

BULLETIN No. 7

Investigations in the Proportioning of Concrete for Highways

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The Effect of Transportation Methods and Costs on the Crushed Stone, Sand and Gravel, and Slag Industries

BULLETIN No. 9

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Stone Sand

Single copies of the above bulletins are available upon request.

Manual of Uniform Cost Accounting Principles and Procedure for the Crushed Stone Industry ($2.00 per copy)

The Crushed Stone Journal

Official Publication of the NATIONAL CRUSHED STONE ASSOCIATION

J. R. BOYD, Editor

NATIONAL CRUSHED STONE ASSOCIATION

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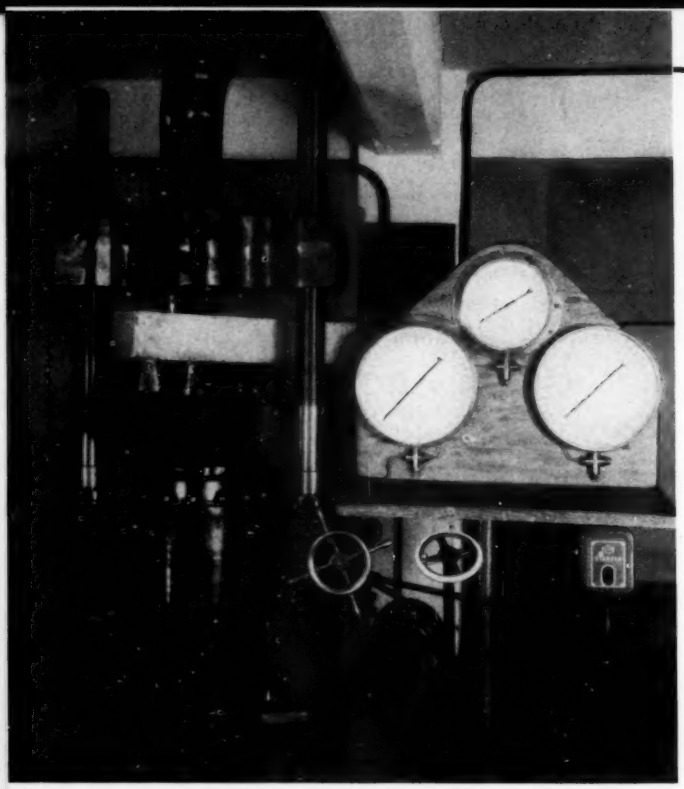

Universal Testing Machine

Views in the Research Laboratory

of the

National Crushed Stone Association

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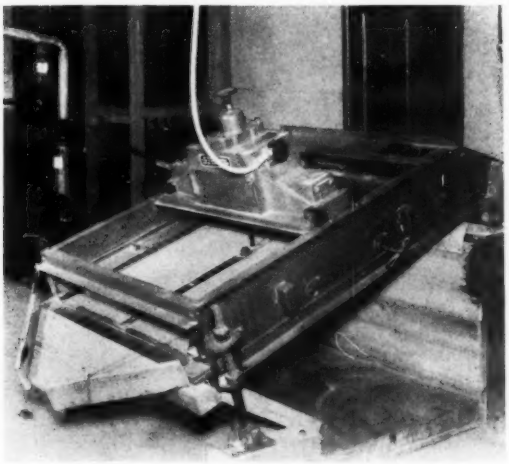
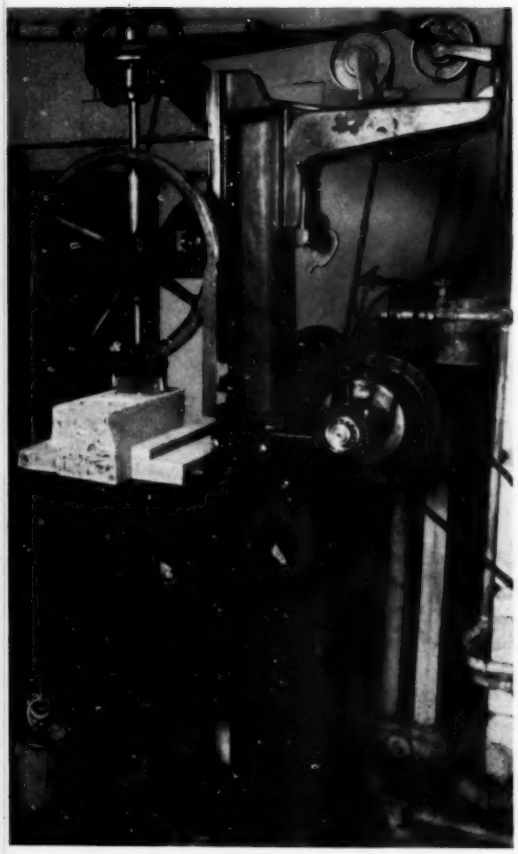
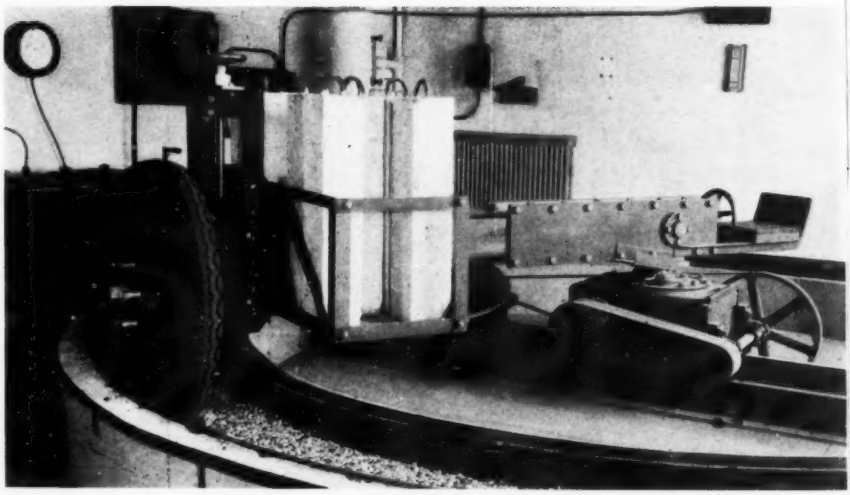
The Bureau of Engineering of the National Crushed Stone Association is constantly engaged in conducting research investigations of value to the producers and users of crushed stone.



Vibrating Screen for Sizing Material



Apparatus for Testing Wear Resistance of Concrete



Circular Track Apparatus for Testing Bituminous Mixtures

THE
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Some Thoughts On:

(1) Concrete Durability
(2) Concrete Proportioning
(3) Non-rigid Road Surface and Airport Runway Design
(4) Bituminous Surface Treatment

By A. T. GOLDBECK

Engineering Director, National Crushed Stone Association

• The production and use of crushed stone while seemingly not too complicated, frequently gives rise to varied and difficult problems. The following discussion of some of the more important ones should prove interesting and profitable.

THE production and use of crushed stone would not seem to be too complicated and, yet, many problems, widely different in nature are continuously confronting the National Crushed Stone Association. It has been our experience that they frequently give rise to difficult questions some of which may be interesting and might be discussed with profit. Let us bring a few of them to light, perhaps somewhat disjointedly, but at least bundled together under separate subjects.

(1) Concrete Durability

First, let us consider concrete durability and some of the problems which are entailed. When we use materials, we would like to feel certain that they will be durable under the exposure conditions to which they will be subjected. Of course, we could more or less insure high durability by selecting materials having the very highest resistance and by using the utmost care and all the knowledge we possess in making durable concrete. But there still would be some failures and, furthermore, this method would be extremely expensive because of our rejection of materials, which, although not the best, still are suitable enough and at the same time are more available and more economical than those which have the very highest durability and resistance to the weather. No doubt from an engineering and economic point of view those materials should be employed which are at least suitable for the intended purpose, without having to incur the expense of importing other materials of the very highest durability, transporting them, in some cases from a great distance. Accordingly, it would be desirable if we could say with finality that a proposed aggregate would be entirely suited for a given purpose if it would withstand a certain kind of accelerated test. Unfortunately, it cannot be stated at the present time that either laboratory tests or their correlation with service behavior have reached such a state of perfection.

At present, to all intents and purposes, we have two durability tests for aggregates and one for concrete. With aggregates we use either sodium sulfate or magnesium sulfate to simulate freezing conditions or we make an accelerated freezing test. With concrete we use only the freezing and thawing test. The assumption is that with these tests

we shall be able to predict whether these materials will be suitable in service. The question may well be asked whether a freezing and thawing test or a sodium sulfate test is comprehensive enough to include the various influences which produce lack of durability in structures. It might not be amiss to be more explicit in pointing out some of the questions which appear to be basic in their nature and which have an important bearing on the entire matter of durability.

Obviously, if concrete or aggregates disintegrate, some inner physical force must be at work which has exceeded the resisting capacity of the material, or there has been some chemical attack. Concrete is a heterogeneous material. Its constituent parts have different values for coefficient of thermal expansion. There may be a high range in temperature within the concrete mass and, consequently, a tendency for relative motion to take place between the aggregate and the mortar or between the fine aggregate and the cement. This tendency toward relative motion sets up stress, perhaps high tension, or high shearing stress or high bond stress between the coarse aggregate and the mortar. This is a basic phenomenon which always exists, but how important is it in connection with concrete durability? There may be a *tendency* to produce high stress and yet it does not necessarily follow that that stress will be high enough to cause disintegration. What is the influence of smoothness of particle on the release of bond under such circumstances? What is the significance of thermal coefficient of expansion as applied to the aggregate or to the mortar? These are questions about which we know too little.

Concrete shrinks upon drying and it is the mortar or rather the cement which shrinks and not the aggregate. Again, we have a tendency toward relative motion which must have its effect in creating stress, perhaps an important effect in accelerating the disintegration due only in part to freezing and thawing.

Atmospheric temperature changes produce temperature fluctuations in the concrete. If these changes in temperature are sudden, a high differential in temperature may be brought about within the concrete mass. A sudden decrease in temperature will tend to make the outer surface of the concrete contract while the inner portion still remains expanded. If this decrease is great enough or sudden enough, the tensile resistance of the concrete might well be exceeded. In the laboratory we have caused severe cracking of the surface of concrete specimens by only 60 cycles of a sudden temperature change of 70°F. Certainly, this seems like an important effect which warrants more study to determine the suddenness with which temperature must change to be detrimental. Also, the indications are that a study of the heat characteristics of concrete would be important.

Evidently, if the suddenness of temperature change is important in its effect on the disintegration of concrete, the question of just how to make a freezing and thawing test remains very much in doubt. Very great damage can be done by sudden changes in temperature, but if those sudden changes do not occur in service, then false indications will be obtained in a freezing and thawing test conducted with violence.

There is some question about the physical conditions under which freezing of a detrimental nature takes place in concrete. For illustration, we are told that water freezes with difficulty in spaces of capillary dimensions such as typified by the pores in concrete and that a very low temperature might be required to produce freezing under such circumstances. A study of this matter as applied to concrete would be important and might well show the way to produce concrete of higher resistance to freezing.

Concrete in service is not all subjected to the same degree of saturation and of course this must affect the severity of the freezing action. Complete saturation will necessarily lead to rapid disintegration if ice actually forms in the concrete pores, whereas partial saturation allowing room for expansion of the ice may result in saving the concrete from disintegration. Accordingly, the degree of saturation of the sample is a basic matter which needs study in connection with the making of freezing and thawing tests of concrete. Also, efforts should be made to learn the degree of saturation of concrete under different exposure conditions so that the laboratory tests might be finally correlated with service behavior.

Here is an interesting thought, which, under certain circumstances may have a great deal of importance as it concerns concrete durability. Ice behaves like any other solid material. It has a linear coefficient of expansion per degree Fahrenheit of 0.000028,—roughly five times that of concrete. Suppose the pores of concrete are filled with ice at low temperature and that the temperature rises until thawing takes place. The ice would then behave like a solid and as the temperature increases up to the thawing point, the ice would expand more than the surrounding concrete and disruption would

occur. There may be circumstances which make this expansion of ice an important consideration. For illustration, consider a concrete road on a wet subgrade. Water may continue to creep upward by capillary action or by vaporization and condensation during freezing weather and it seems not impossible that through this continuing action, the pores in the surface of the concrete may become completely filled with water and finally with ice at a low temperature. As the temperature rises to the melting point, the ice expands and could cause disintegration of the concrete road surface. Thus far, this is merely a thought, but does it not seem important that it be investigated to see if it does have importance in connection with concrete disintegration?

We make the same kind of accelerated soundness test on all aggregates, but are we right in assuming that the durability of aggregates of all kinds can be suitably detected by an arbitrary form of accelerated soundness test? Some aggregates are affected by water alone. It may take time to bring about the necessary chemical change, but very severe disrupting forces are created when that change does take place. Then, again, some aggregates are affected chemically by salt solutions and consequently the accelerated test produces an artificial disintegrating effect which does not exist in service. Obviously, there is something wrong with such an accelerated test as applied to such materials. Quite apparently, an arbitrary form of accelerated soundness test may not be adequate and may, furthermore, give entirely misleading results.

Some aggregates may cause trouble due in part to their high coefficient of thermal expansion, or to an extremely low thermal coefficient; in part to their high absorption and perhaps also due to their surface characteristics, their relative roughness or to the characteristics of that roughness. All of these matters need intense study.

No doubt there are numerous basic problems which should be studied as applied to cement as well as to the aggregate and fundamental studies of concrete durability certainly would not be complete without certain fundamental studies of cement, including such matters as compound composition, uniformity of burning, fineness, and perhaps even the mechanical analysis of the cement.

One might get the idea that testing engineers know very little about how to study the durability of aggregates or of concrete, but, as a matter of fact, in spite of inadequate knowledge of some of the fundamental problems such as above enumerated, tests have continued to be of very great value in leading to the use of suitable materials.

(2) Concrete Proportioning

Engineers have been struggling for many years to devise a rational method for determining the proportions of concrete which will be best suited for the particular job under consideration and a number of methods have been suggested. The comprehensive investigations conducted many years ago under the able direction of D. A. Abrams, which led finally to his statement of the average relationship which then existed between the compressive strength of concrete and the water-cement ratio was a very important step in the more rational design of concrete mixtures. In the meantime that relationship has changed numerically due to a difference in cement. The realization that only a portion of the mixing water combined with the cement and that the remaining water affected the porosity of the concrete and likewise its durability was still another important factor leading to more rational concrete design. Perhaps the most widely used method for designing concrete today is the so-called water-cement ratio method. It is applied (a) with the aid of laboratory tests and (b) without special tests, but, instead, use is made of an average water-cement ratio curve.

(a) In the laboratory method, a selection is made of the water-cement ratio, frequently stated in gallons per sack of cement, which experience or judgment seems to indicate is the maximum for adequate durability, which should be used for the particular type of structure and exposure conditions. A table of such values occurs as Table I in the 1940 Report of the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete.

The next step is to determine the maximum size of coarse aggregate that should be used and this depends in turn upon the nature of the work. In general, economy results in using the largest maximum size that the structure will permit. The question of size and spacing of reinforcing steel, size of concrete member and whether the concrete is plain or reinforced or is mass concrete, will govern that selection. Laboratory tests are then supposed to be made using the water-cement ratio required for durability to determine if it also gives the desired strength, or tests are made using several lower water-cement ratios to determine that value required to give the necessary strength. Laboratory mixes are made with different ratios of fine to coarse aggregate using the proper water-cement ratio and the consistency, as

measured by the slump test, thought desirable for this work. On this basis that concrete mixture is selected which is the most economical and which complies with the requirements for maximum allowable water-cement ratio and slump. The smallest percentage of sand which will produce the desired plasticity or workability is generally thought desirable. Final adjustment of the mix is made on the job.

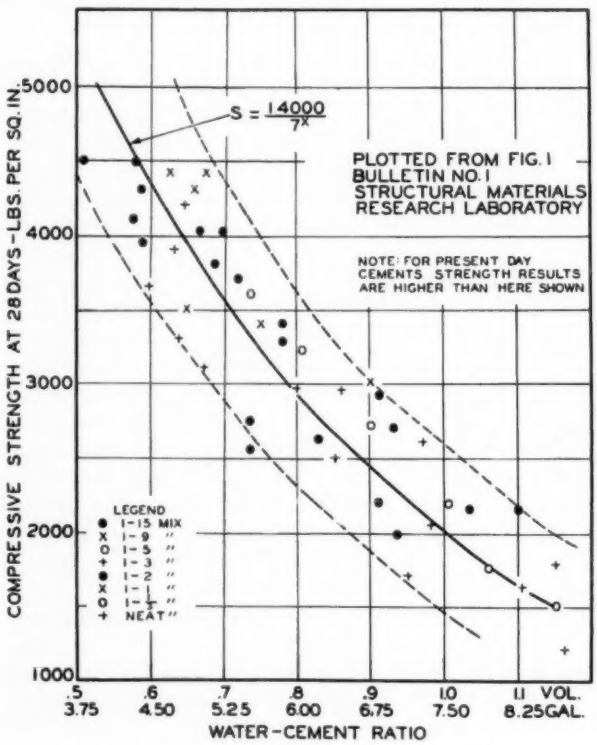

FIGURE 1.

Very seldom does the water-cement ratio, necessary for a given strength, control the design of the mixture, except possibly in the case of highway concrete where high beam strength is important and, consequently, that water-cement ratio which is designated for controlling durability is generally the critical value and that automatically results in a higher cement factor for one type of aggregate as compared with another.

(b) If laboratory tests are not feasible then the water-cement ratio is taken as a rather conservative value selected from tables which are supposed to represent average experience.

When no tests are made it is assumed that no matter what the coarse aggregate, provided it is sound, the use of the selected water-cement ratio insures concrete of sufficient durability and strength. On the average, this is not an unreasonable assumption. But thorough tests would show that different aggregates require different cement factors and different water-cement ratios to produce concrete of like strength and durability.

Let us examine a few points in connection with this theory and ask ourselves whether we may not be unnecessarily discarding good materials because of the omission of factors which a more complete concrete design theory should take into account.

(a) A concrete structure is usually supposed to last a long time and the concrete in that structure may have to serve in different ways, depending upon what the structure is, whether a pavement, a dam, or a reinforced concrete building. The various concretes under preliminary consideration in the design stage, must be designed to give the same consistency as measured by a slump test, the idea being that as nearly as this is feasible, the respective concretes will then be capable of being placed with equal ease. But as long as the concrete can be placed satisfactorily with not too much difficulty, is it not more important that it be designed for the ultimate properties it should have, rather than for its ease of placement? Undoubtedly, the most durable concrete structures were those built many years ago with concrete which had to be rammed in place and not poured. I question seriously whether ease of placement and its effect on cement factor should be taken as a criterion for the relative suitability of two concretes. The harsher working concrete may be far more suitable to serve its ultimate purpose than the concrete which may be placed with greater ease.

(b) It must be quite obvious to any one who has examined different kinds of coarse aggregates, that their surface textures vary widely. Some aggregates are extremely smooth and polished; others break with a rough fracture. There are many other characteristics of aggregates which differ over a wide range such, for instance, as absorption, physical properties measured by the abrasion or toughness test and coefficient of thermal expansion. These different aggregate characteristics are neglected in the water-cement ratio method of designing concrete and yet some of them have a very decided later effect on the strength and durability of the hardened concrete.

(c) Is it fully realized that the water-ratio strength relationship is merely an average relationship from which there are departures of significant amount?

Let those who are so insistent on the infallibility of the water-cement ratio as a measure of strength and durability again study Prof. Abrams' Bulletin No. 1, of the Lewis Institute, especially the really significant water-cement ratio, compressive strength results. In Fig. 1 is shown that portion of the original curve from Bulletin No. 1 which encompasses most of the concrete mixes generally used in practice, namely, those having a range of from 5 to 8 gal. of water per sack of cement. The original test results lie within a band shown by the dotted lines and it will be seen that the ranges of strength results are as follows:

Water-Cement Ratio		
By Volume	Gal. per Sack	Compressive Strength
.6	4.5	3600-5500
.7	5.25	2900-4300
.8	6.00	2300-3600
.9	6.75	1900-3000
1.0	7.50	1500-2500
1.1	8.25	1200-2200

Note from the above table that identical strength was obtained for wide ranges in water-cement ratio. Take a specific example from the curve, that of concretes having a strength of 3000 lb. per sq. in. This was obtained with concretes having water-cement ratios extending from a minimum of 5.1 gal. per sack up to a maximum of 6.75 gal. per sack. These results varied that much in spite of the fact that the concretes were made with the *same* materials mixed in different proportions. Had *different* materials been used, the variation in results would have been even wider. These concretes, furthermore, were all cured under very carefully controlled conditions. Take those same mixes into the field and a still wider band of strength values for the same water content ratio will result. A classic example of that fact is the water-cement ratio-compressive strength curve obtained in the construction of the Portland Cement Association Building, in Chicago, (See Fig. 2) where the most careful control by expert technicians was presumably exercised.

In the field cured specimens used in Fig. 2 there is a surprising variation in strength for the same water-cement ratio; for illustration, with 7 gal. of water per sack of cement, the strength varied from a minimum of 1200 to a maximum of 4500 and for the other water-cement ratios shown, extremely wide ranges in strength were obtained. A strength of 3000 lb. per sq. in. was obtained with concretes varying in water-cement ratio from a minimum of 5 to a maximum of 8 gal. per sack of cement. This range is due to factors not even considered in the water-cement ratio theory of design. To some extent they are not controllable in practice. And yet a variation of as little as a few tenths of a gallon of water per sack of cement to produce a given consistency is used as a reason for rejecting one aggregate in favor of

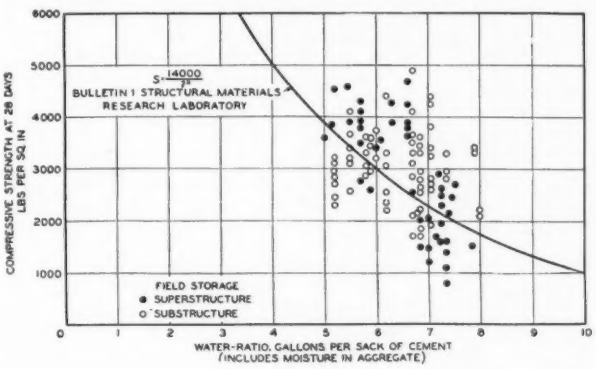

FIGURE 2.

COMPRESSIVE STRENGTH—WATER CEMENT RATIO RELATIONSHIP FROM FIELD SPECIMENS, PORTLAND CEMENT ASSOCIATION BUILDING, CHICAGO (*From Eng. News-Record, Vol. 96, No. 17*)

another. Surely the facts do not warrant any such inflexible use of the water-cement ratio strength relationship. By no means is this relationship that clearly defined. In the practical application of any theory it is important to recognize its limitations.

(d) A constant water-cement ratio is supposed to insure practically constant durability. Is it reasonable to expect the same durability from concrete which may vary in strength from many causes by several thousand pounds per square inch, despite a constant water-cement ratio? The strength of the concrete surely has something to do with its resistance to the disintegrating forces produced by exposure to the weather. Quite evidently the water-cement ratio theory of concrete design is not exact enough to warrant using it, as too frequently is the case, for the selection of one aggregate as compared with another. Some aggregates produce concrete of greater strength and greater durability than other aggregates in spite of the use of a higher water-cement ratio to obtain the necessary consistency, but that fact is not recognized by the water-cement ratio method.

The question arises then, What would be a more suitable and more trustworthy method? The probable answer to that question is that at the present time there is no method except by the use of complete laboratory tests, including freezing and thawing as

well as strength tests made on mixtures of different proportions. On this basis the mixtures could be selected, which to all intents and purposes have similar properties, even though made up with different kinds of aggregates. Only through the making of *complete* tests appropriate to the structure can the proper proportions with the different aggregates be determined.

If such tests are not practicable, then it seems entirely reasonable to require the same cement factor for a given class of concrete, irrespective of the aggregates, varying the water-cement ratio slightly to obtain the desired consistency and varying the sand-coarse aggregate ratio as may be needed to obtain workability, but using a limiting water-cement ratio for each class of concrete. Under this method a given cement factor, the same for all aggregates, and a limiting water-cement ratio would be specified for each class of concrete, likewise a given consistency, depending upon the type of work to be done. The initial design procedure in the laboratory for establishing different classes of concrete would consist in determining the proper ratio of fine to coarse aggregate for workability and the determination also of the amount of cement necessary for each given class of concrete so that the limiting water-cement ratio for that class will not be exceeded. All of the aggregates would be required to have the same cement factor, but slightly different water-cement ratios and somewhat different sand factors.

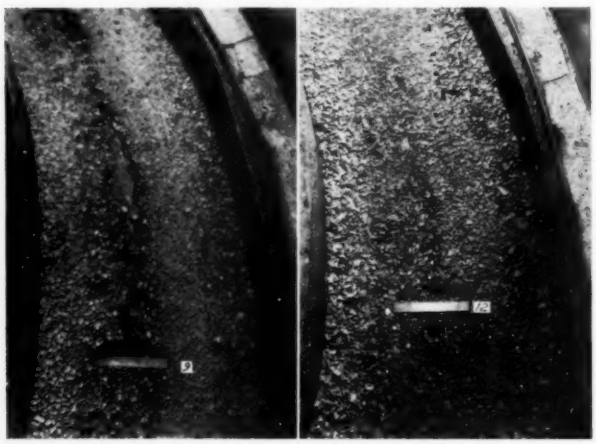

FIGURE 3.

A COMPARISON OF SURFACE TREATMENTS AFTER 5500 PASSES OF PNEUMATIC TIRE, SURFACES WET. ONE SURFACE HAS FAILED; THE OTHER HAS NOT. *(Circular Track Tests by the National Crushed Stone Association)*

Such a method of design which applies the water-cement ratio principle to *classes* of concrete has the advantage of making it possible for the different aggregates to compete, whereas a strict application of the water-cement ratio method of design practically limits the coarse aggregate to one type, in spite of the fact that the other types may produce just as suitable concrete and just as economically as the more favored type. The practical results obtained would have no wider variation under this method than they would have under the more restrictive water-cement ratio method. Furthermore, in practice it is much easier to insure the use of a constant cement factor than a constant ratio of water to cement. The requirement of a given cement factor is a good safeguard of the quality of the concrete.

Alternate B of the Joint Committee Specification is a method of specifying the proportions of concrete by the use of a designated cement factor. This method is widely used for highways and other types of construction. It should have more general use for it gives good results with no pretense at impractical accuracy.

(3) Non-Rigid Road Surface and Airport Runway Design

About a year ago, in the August-October, 1940, Crushed Stone Journal there appeared an article by the writer entitled, "A Method of Designing Non-Rigid Pavements for Highways and Airport Runways." This method was evolved by first measuring the distribution of subgrade pressures produced by loads of 4000, 8000 and 12,000 pounds applied through elliptical bearing blocks having the actual contact areas of tires suitable for these loads. Formulas were then developed for thickness in which the *actual* subgrade pressure distribution was taken into account by the rather simple expedient of expressing it in terms of computed uniform pressures on the subgrade, spread over an area defined by confining lines of 45 degrees extending down from the tire imprint area. It was assumed that it would be safe to allow the maximum subgrade pressure, which occurs only at the peak of the pressure curve, to equal the bearing value of the soil when measured in a given way.

No pretense was made as to extreme accuracy in the method, but at least it was founded on test results obtained under carefully controlled conditions. As yet, no one has produced facts to show that the suggested method is too incorrect. When the subgrade is soft, it leads to rather substantial thicknesses. This is not unreasonable, but there has been a misinterpretation of intent which needs correction.

Some engineers have inferred that it will be necessary to make the non-rigid layer of the same strength or same type throughout its thickness. That was not intended by the writer. For illustration, suppose the calculated thickness necessary to support a plane load of 22,500 lbs, is 12 in., the subgrade having a supporting value of only 27 lbs. per sq. in. The wearing surface is to be bituminous concrete. It is not at all necessary to make the entire thickness of bituminous concrete, but, instead, a bottom layer of say 6 inches could be made of screenings stabilized soil, or a layer of crusher run stone; then there could be a foundation course of 4½ inches of either water-bound macadam or bituminous macadam, or lean bituminous concrete with an upper wearing surface of 1½ inches of fine graded bituminous concrete. It should go without saying that when the subgrade is very weak the most economical procedure is to stabilize it and thus give it a higher bearing value, for when this is done a very much lesser thickness of non-rigid wearing course is then necessary. The problem of how deep to make a stabilized layer to properly support a given wheel load transmitted through a foundation course, by no means is completely solved, but by using the method of attack described in the original article on method of design, the problem can be solved for each individual case. Too frequently, runways are built without investigation enough to insure that the thickness is adequate. Not a little preliminary field investigation would be warranted before building a structure as expensive as a runway. A possible wheel load of 70,000 lbs. certainly should not be ignored.

(4) Bituminous Surface Treatment

In several ways it has been brought to the writer's attention that single or double surface treatments, at times give variable results in that they seem to have too much or too little bituminous material. This defect is not at all surprising. Specifications generally permit the use of a range in quantity of bituminous material per square yard and likewise a range in amount of cover material. Further, the gradation specifications, must provide a tolerance in size for otherwise the aggregates could not be produced. In addition, aggregates differ in character and in this word "character" there are a number of physical properties involved. Suppose, in laying a given bituminous surface treatment, the maximum permissible amount of bituminous material is used and the aggregate happens to be so graded that it has about the greatest density and the least voids possible under the specifications. Here, we have a combination in which the voids will be as small in volume as possible and the quantity of bitumen will be as large as possible. It would not be surprising to find that the bitumen has flooded up through the voids and covered the surface after being compacted by traffic. On the other hand, suppose the minimum allowable amount of bitumen has been used and the gradation is more or less open so as to give a high percentage of voids, thus providing plenty of space for the asphalt to be retained without coming to the surface. In this case no welling up of the bitumen takes place, and the surface remains free of asphalt. These various conditions have actually been tried in the laboratory of the National Crushed Stone Association and it is known that the effects cited do take place.

The lesson to be drawn from this is that those who are performing bituminous surface treatment construction should determine, by some means, the proper amount of bituminous material to use in connection with the particular cover material available. It is first necessary to find out how many pounds per square yard of cover material are actually necessary. This can be done by very carefully covering, say a square foot of surface, with the cover material, weighing that material and converting the weight to pounds per square yard.

The determination in the laboratory of the proper amount of bituminous material to use is not so simple. It would be desirable if the bituminous material were to extend up into the voids, say about 2/3 of the depth of the stone, after the surface has been subjected to rolling and to traffic. Those laboratories which are equipped with a circular track testing apparatus such as our own would find it a very simple matter to determine the proper amount of bituminous material, the procedure being merely to construct a half dozen small sections, some 8 feet in length, using different amounts of bituminous material, with a given amount of cover, then subjecting these different sections to the action of the roller and to traffic. In this way, in the course of 2 days' running of a pneumatic tire over the respective sections, the line of demarcation between too much bituminous material and the proper amount, can be very readily determined.

The above are random thoughts on problems we have had to consider. Crushed stone truly is a remarkable material. It gives rise to many surprising questions.

BY THE PRESIDENT OF THE UNITED STATES OF AMERICA

A Proclamation

The Nation is confronted with a rapidly rising accident toll. At the present rate, the total number of deaths from accidents this year will exceed 100,000. Traffic accidents alone caused 34,500 deaths in 1940, and thus far in the present year there has been an increase of seventeen per cent in traffic fatalities.

By taking a huge toll in life and property, accidents definitely hinder our national defense effort. To insure maximum efficiency we must have maximum safety twenty-four hours a day—not only at work, but also on the highway, at home, everywhere.

The troubled times in which we live must not make us callous or indifferent to human suffering. These unusual times require unusual safety efforts.

NOW, THEREFORE, I, FRANKLIN D. ROOSEVELT, President of the United States of America, do hereby call upon the officers and directors of the National Safety Council to mobilize its nation-wide resources in leading a concerted and intensified campaign against accidents, and do call upon every citizen, in public or private capacity, to enlist in this campaign and do his part in preventing wastage of human and material resources of the Nation through accidents.

IN WITNESS WHEREOF I have hereunto set my hand and caused the seal of the United States of America to be affixed.

DONE at the City of Washington this eighteenth day of August in the year of our Lord nineteen hundred and forty-one, and of the Independence of the United States of America the one hundred and sixty-sixth.

Franklin D. Roosevelt

By the President:

Cordell Hull

Secretary of State.

These Unusual Times Require Unusual Safety Efforts

SO STATED the President of the United States in a Proclamation (shown on the opposite page) issued August 18th, in which he called upon every citizen in public or private capacity to enlist in a campaign to do his part in preventing wastage of human and material resources of the Nation through accidents.

The National Safety Council was asked by the President to mobilize its Nation-wide facilities to lead the campaign. The seriousness of the situation is evidenced by the fact that deaths from accidents this year will exceed 100,000. Traffic accidents alone in 1940 caused 34,500 deaths and to date there has been an increase of seventeen per cent in traffic fatalities.

The crushed stone industry has a direct responsibility to exert every possible effort to reduce accidents in the crushed stone industry. Real progress can be made in this direction by observing the following principles as outlined by the National Safety Council:

1. The first requirement for industrial safety—and no program can be successful without it—is the wholehearted support of management. Especially during this emergency, the industrial executive should support safety so actively that his enthusiasm will be carried to every foreman and worker. The manager must demonstrate his conviction that safety and efficiency go hand in hand.

2. Accident investigation is the only sure way to determine the safety program's direction. Every accident, even though minor, should be accurately reported and thoroughly investigated to determine its underlying causes, how to prevent a repetition, and who is responsible for corrective measures.

3. Experience has shown that industrial accidents cannot be prevented unless operations are made mechanically safe. This means good working facilities, adequate machine guarding, personal protective equipment, safe planning of operations, well maintained equipment, etc. Unsafe mechanical conditions can be determined by safety inspections and by accident investigations.

Management must be willing to spend time and money to correct unsafe conditions. Employees cannot be expected to work safely unless they have a safe place in which to work. The present emergency has accentuated this potential cause of accidents. Maintenance in many industrial organizations has suffered because of increased production pressure, difficulty in obtaining materials, etc.

4. Eighty-seven per cent of all industrial accidents are caused, at least in part, by an unsafe act on the part of the employee. To get an employee to do a job the safe way, management must make sure of three things:

First, that the employee is physically able to do the job, without being handicapped by poor eyesight, poor hearing or other defects.

Second, that he understands how to do the job safely. This can be accomplished only through adequate instruction and persistent supervision. The problem is especially acute now, due to thousands of new workers in industry. It can be met only by increased attention to selecting and training a competent supervisory staff.

Third, that the employee's attitude toward safety is cooperative. This can result only from good working conditions and whole-hearted insistence on safety by management.

The Indispensable Quality of Highways to the National Defense[1]

By THOS. H. MacDONALD

Commissioner of Public Roads
Public Roads Administration
Washington, D. C.

• **That highways are indispensable to an adequate national defense would seem to be axiomatic notwithstanding the difficulties which have been encountered in obtaining sufficient funds with which to undertake needed construction to bring our highway system up to the minimum requirements of the War Department. Mr. MacDonald's observations concerning the problem of defense highways is both timely and informative and should be studied by all interested in the highway field.**

IN THE June 1941 issue of *Current History and Forum* Mr. Frederic Sondern, Jr., Former Foreign Correspondent in Germany, has rendered a great service for all of us in this country. He has disclosed the factual background, and step by step described first, the development of the conception of Germany as the dominant world power, and in sequence the building of a vast organization for planning and for gathering data as a basis for the planning through world-wide espionage, in addition to those official representatives generally accepted in good faith by and between all nations. With the background now supplied we should be prepared to accept without shock any disclosures of espionage. And we have the knowledge of just why events have shaped themselves as they have. The following is quoted from Mr. Sondern:

"For the fourth time in 20 months Germany has rolled its forces irresistibly against the weakest points of its opponents' defenses at exactly the right moment. No army has ever been so precisely led, so effectively directed, or had the way so thoroughly prepared for its advance with propaganda, political sabotage, and economic pressure.

"The development of this formula of destruction and the split-second timing which has sent the Nazi juggernaut rolling across Europe without serious hindrance is the work of one man.

"Major General Professor Dr. Karl Haushofer and his Geo-Political Institute in Munich with its 1000 scientists, technicians and spies are almost unknown to the public, even in the Reich. But their ideas, their charts, maps, statistics, information and plans have dictated Hitler's moves from the very beginning.

"Here is an organization for conquest, a machine for scientific planning, which no conqueror before Hitler ever had at his command."

The resulting coldly calculated, scientific methods for world conquest integrating motor powered equipment on the highways and in the air is accurately reported in a June, 1941, Memorandum by Lt. Col. Lacey V. Murrow, former State Highway Commissioner of the State of Washington. Col. Murrow was temporarily released by the Army Air Corps, at the request of the Federal Works Administrator, to go to England for the purpose of observing the demands upon highway services and the relationships between air services and highways which have grown out of the titanic European war operations. The following is quoted:

"Rapid flexible transport chief factor in the new form of warfare.

"Adequate modern transportation has proven to be one of the greatest single factors in present offensive or defensive warfare. In all of the campaigns in which the German Army has thus far been engaged, rapid transportation facilities have been of the greatest importance. Perhaps in no single instance was this fact more clearly demonstrated than in the battle of France.

"Discussions with French, Belgian, and English officers, who participated in and observed the full extent of this operation, disclose two most interesting facts. The German Army made full use of the entire road net, and it has been stated that there was little or no cross-country movement of tanks or other mechanized units. Every detail as to the movement, supply, and maintenance of these mechanized units was carefully worked out in advance. Allied aerial observation reports indicate that there was never at any time confusion or congestion on the various por-

[1] Presented at the 27th Annual Meeting of American Association of State Highway Officials, Detroit, Michigan, September 29, 1941.

tions of the road system that were being used by the advancing German Army.

"Unorganized transport a fatal weakness in France.

"On the other hand, it was stated by the same officers that there was utter confusion insofar as traffic was concerned behind the Allied lines. After the break-through at Sudan, there was no semblance of order in the movement of either military or civilian traffic. There was apparently no successful attempt at segregation and no establishment of priorities for certain classes of traffic. Records on file in the British War Office describe road blocks in France extending for miles and lasting for many hours made up of all classes of refugee vehicles and all classes of military transport. It would appear that only behind the British held sectors was there any semblance of order."

But this nation is not engaged in war. The national effort is directed toward two great objectives, the mass production of material of war for ourselves and for those nations who are valiantly defending themselves from aggressor nations, and simultaneously the building and equipping of an adequate army and navy for our own protection.

We know we are facing two periods of crisis, the immediate future of a life and death struggle involving the nations of the world to an extent we cannot yet know and then, sooner or later, the aftermath of dislocated industry, unemployment, debts and unprecedented, world-wide social and economic disaster.

It is only intelligent to accept that all this disruption in the life of the world, the momentum achieved first by the German Nazi political party, and now by the German war machine, have advanced from a street brawl in Munich to a domination of most of the countries of Central Europe as a climax of a decade of painstaking, scientific planning and production. These elements of German national policy have converted mechanical power and engineering invention, designed to free men from the tyranny of physical labor, into coordinated weapons to impose upon nation after nation, the tyranny of a dictator's fancy. No matter what we think of the ethics between nations that are violated, no matter how immeasurable the suffering, the destruction, the loss of economic and social independence of the conquered nations, the conditions exist. These are real and are to be faced. This places the problem of what to do, what attitude to take, squarely before every individual. In our particular capacities of highway officials the responsibility is greater than the average. With each one it is not a question of individual action. It is a matter of official attitude and leadership. The responsibility extends beyond the limits of a locality, even a State, and for each of us pertinently raises the question, what is my responsibility to the nation as a whole? In this national crisis, what contribution can I, as a highway official, make that will advance the interests of the nation?

The experience of the past few months has been illuminating. Since it became evident that the nation was in danger, there has been generally a response from the highway officials in attitude and in action that glorifies the spirit of solidarity of the highway organizations in the service of the United States. The measure of this response is indicated by the facts.

Directly in the interest of national defense, a program has been launched consisting of work on the strategic network and on access road projects, which as of August 31, 1941, embraces a total of 6,105 miles of programmed and approved highways.

On the 78,000 mile strategic network, 1159 miles have been completed at a total cost of nearly $29,000,000; 4,288 miles have been approved for construction to cost in excess of $172,000,000; and an additional 1,517 miles have been programmed to cost approximately $64,000,000. The total programmed and approved mileage of strategic network, 5,805 miles, is estimated to cost $236,606,000, of which $127,565,000 or 54 per cent is to be paid with Federal aid funds. The program on this system also includes 885 structures and work on grade crossings to the extent of 145 eliminations and 105 protections.

Approximately 300 miles of access road projects have been programmed and approved at a total cost of $26,478,000 on which the Federal share is about 57.5 per cent or in excess of 15 million dollars. Surveys also have been authorized or engineering supervision is being supplied on over 1,450 miles. This work includes 58 structures and grade crossings work comprising 13 eliminations and 10 protections.

In a few States,—it may be accented, in a very few States,—there has been a meager response. The theory advanced is that defense highways are a responsibility of the national government. This attitude prompts the question—whose nation is this? The very essence of our national philosophy pivots upon our individual willingness to sacrifice political and personal interests to advance the common good. In no other way can the democratic principles under-

lying our national life be preserved. Because of these principles men as individuals are free within the laws to choose their own course. As public officials, they must accept the limitation upon their official decisions that is dictated by the advancement of the common good. In the time of national distress, there is no place for self interest or partisan politics. The record is now in the course of being written.

TRAFFIC JAM ON U. S. ROUTE 40 BECAUSE OF STOP LIGHTS AT INTERSECTION NEAR BALTIMORE, MARYLAND

What has been accomplished on our highways during the past year to meet the known deficiencies measured by defense needs, has been through the generous cooperation of the State highway departments through adjusting their current programs and the directing of expenditures of State and Federal funds to this end. There is no doubt that Federal legislation will be enacted that will materially augment these efforts. This is certain. However, there is a growing responsibility for both State and Federal highway officials. This is to concentrate upon the program of action that will insure the adequacy of indispensable services that can only be rendered by the highways. Transportation of persons and commodities over the highway has become so interwoven with the fabric of the life of every individual and all industry that, like the air we breathe, it is accepted without conscious thought. Highway service has become indispensable to our national life in normal times and much more in times of national emergency.

The universal transportation fallacy is in thinking of the units that move, and not the combination of the units that move and the roadbeds over which they move. This is true of all forms of transportation.

No matter how well the motive power and car equipment of the railroads are managed, efficient rail transport is dependent upon the constant day by day maintenance, including betterment and replacement of roadbeds and bridges. No matter how advanced the design of airplanes, they are dependent upon adequate runways to get off the ground or to land with safety. It has certainly been well demonstrated there is nothing more helpless on the ground than an airplane. Their effectiveness for either defense or offense depends upon how rapidly they can be put into the air.

So with motor transport. Adequate highways and bridges and organized operation are fundamental to their utility, and this can become accented with accelerated swiftness in an emergency. In his report of May last to Major E. W. Ridings, the head of the Civil Defense Mission which was sent to England in March of this year, Mr. Frederick C. Horner, a member of the Mission, assigned to study transportation and public utilities, quotes the Chief Engineer of the British Ministry of Transport, Major F. C. Cook, a highly competent engineer of long service in this capacity, as follows:

"You must have alternate highway routes and you must plan now—ahead of the emergency—how you propose to use them. In England no effort was made before the war to work out strategic roads because we never expected invasion. You should not make that same mistake.

"Give your highway engineers who are experienced in these matters full control of the highways, repairs, and maintenance of both bridges and carriageways. Let the military authorities, working in the closest cooperation with the highway engineers, make the plans, but wherever possible, even including the theatre of war, let the highway engineers do the work."

Conceding the differences between a nation heroically defending itself through months now lengthening into years, and a nation turning its whole energies and resources at a rapidly accelerating rate toward preparedness to defend itself and to render essential assistance to other nations, the statement of Major Cook concisely, authentically defines the place in the organized plan for effective action that can be best filled by the highway officials in the providing of adequate highway facilities. In the broader field of highway transport, there must be complete coordination with the motor vehicle administrators,

with the State and local traffic control organizations and the establishment of cooperation with and between all classes of road users.

The plans for the orderly, efficient use of highway transport have been progressing but the real effort is yet ahead. Probably the detailed knowledge that we have for quick reference of the condition and capacity of the highways of the nation, particularly the more important routes, is unsurpassed. Just what needs to be done is not a matter of conjecture. The facts are known, and among other things we know there are many many miles of highly important routes that for some time have been loaded beyond their reasonable capacity both as to tonnage and numbers of units. But the work ahead must incorporate more than the remedying of these defects. It must include the orderly planning and execution of a program that continues logically along lines already determined. The steps which have been taken to carry into operation a defense highway program include many related yet widely differing activities. These are here reviewed.

1. *Designation of the Strategic Network.*

Beginning in 1935, the State highway departments and the Public Roads Administration inaugurated cooperative State-wide highway planning surveys which have provided a complete inventory of the highway facilities of the nation. The application and use of the information gained in these studies have proven of inestimable value in the defense effort now being made by this country. The study of events in Europe during the past two years emphasizes the importance of highway transportation to any successful defense or war effort, and requires a system of strategic highways, which, as the name implies, will afford continuity of movement over predetermined routes for military traffic.

The results obtained largely from the planning surveys have provided the basis for the final selection of a strategic network, in the making since 1922, composed of 78,000 miles of highway extending into all sections of the country, taking maximum advantage of existing facilities and affording the greatest opportunity for the unimpeded flow of traffic. Selected in collaboration with military authorities, and finally approved by the Secretary of War, the routes comprising the strategic network connect all major centers of population and are most highly correlated with traffic origins and destinations. The consideration of modernization to meet the needs of swiftly moving traffic in the shortest possible time has been paramount in the final selection of this network. Since that time, the greatest possible emphasis has been placed on the necessity for the speedy correction of existing deficiencies, which from a military point of view are most critical.

2. *Access Road Projects.*

The national defense effort has created a nationwide situation analogous to a major industrial migration. Though an attempt has been made carefully to plan and coordinate the plant expansion essential to defense production and the facilities for defense transportation, nevertheless serious dislocations have been countenanced in the interest of speeding the effort. New and expanded industrial plants for the production of ordnance and aircraft items and for shipbuilding, and the development of Air Corps Training Centers and Replacement Camps have all added to the need for the coordinate expansion of existing access roads and for the construction of many new access highway facilities. The improvement of access roads subscribes only to the general procedure of establishing particular requirements by

TRAFFIC ON EASTERN AVENUE NEAR GLENN MARTIN AIRPLANE PLANT, BALTIMORE, MARYLAND

surveys of individual cases, and of affording relief according to their relative urgency within the limitations of available funds.

As of September, there have been certified to the Public Roads Administration some 400 military, naval and industrial areas for study. In these areas it is anticipated that the construction of 3,150 miles of access road costing $256,000,000 is indicated. In 220 military areas need is indicated for 2,410 miles of access road at a cost of $138,000,000. Some 70 naval areas presently require 340 miles of access road

to cost $67,000,000, and in approximately 110 industrial areas 400 miles costing $50,000,000 are now indicated as necessary.

The importance of adequate access to and from plant and camp and major highway routes cannot be overemphasized. We cannot expect to move trained men and equipment out of camps and plants unless we move supplies and raw materials into them.

3. *Alternate and Auxiliary Routes for Civilian Defense.*

In England, the Ministry of Transport, in cooperation with the Ministry of Home Security and the Military, have laid out a system of strategic and tactical highways. Considerable study has recently been given to the control and operation of this system. Although their strategic system is somewhat like our network, their control and operation are somewhat further advanced by reason of the urgency of their present situation. Military authorities can take full control at any time, including policing, and can exclude all civilian traffic.

In particularly vulnerable areas, carefully worked out schemes provide for the evacuation of civilians over alternate roads not forming a part of the strategic or tactical system. Arrangements have been made for the civilian crossing of the strategic system by civilian traffic on the auxiliary routes with a minimum of interruption to the military movements. The provisioning of canteens in strategic areas has been worked out to facilitate the evacuation of civilians. The thoroughness with which this plan has been developed testifies to the close coordination of the Ministry of Transport, the Ministry of Home Security, the military and the civilian police.

ARMY TROOP MOVEMENTS ON U. S. ROUTE 40 NEAR PERRYVILLE, MARYLAND

One of the next undertakings in which we feel certain of the full cooperation of the State highway departments is the planning of supplementary and alternate routes for civilian use and defense.

4. *Highway Maintenance by Replacement Programs.*

It may be, perhaps paradoxically, stated that the complete highway system is never completed. Over a period of years, a series of construction projects are built up of various surface types designed to meet the requirements of variant traffic volumes and integrated into a system which provides continuity of traffic flow. At any interval in the development of a planned highway system, the relatively small project elements composing it express the complete range of service life, design standard, traffic adequacy and degree of modernization.

In the dynamic advance toward system modernization adequate to the expanding volumes of highway transportation, maintenance is the only static element. Maintenance is properly the function of preserving the initial status of the constructed facilities; —of protecting the assets created by construction during an economical period of service life. Thus, at all times, the variant ages of the project elements composing the highway system require varying degrees of maintenance expenditure to check the forces of depreciation and obsolescence. Maintenance, however, cannot indefinitely offset wear and tear, obsolescence and traffic inadequacy, so that attempts to unduly prolong service life may result in exorbitant maintenance expense, which in turn may inhibit the replacement essential to economical traffic service.

Recent studies of special maintenance cost sections in a number of States have revealed instances of maintenance cost exceeding 50 per cent of all highway expenditure without contributing to essential modernization.

Continual replacement is therefore dictated by continual lapse of obsolete and inadequate projects into a category of uneconomical maintenance. Especially in the defense effort, the systematic and planned replacement of the weak links strained by the defense load is the best guarantee of sustained highway capacity equal to that effort.

It should be more generally understood that the highway programs that are most important now, do not contemplate the building of new highways. The important—the essential work,—is the replacement

of facilities now in use that can no longer provide the required service.

5. *Priorities on Material and Equipment.*

Conferences between the Priorities Division of OPM, the Priorities Committee of the Army and Navy Munitions Board and the Public Roads Administration, resulted in an outline of policy governing the assignment of preference ratings to several categories of highway construction. This policy recognizes the prior defense importance of access road and strategic network construction, but is broad enough to cover all construction activities of the State highway departments.

To implement the policy a procedure has been established providing for the submission, through the Public Roads Administration, to the Office of Production Management, of applications requesting the assignment of preference ratings to groups of projects, appropriately classified. Preference Rating Orders issued to the State highway departments may be used to assure delivery of material and equipment to contractors.

Negotiations are now under way for the issuance of an Order covering the maintenance activities of State and other highway departments.

6. *Highway Traffic Advisory Committee to the War Department.*

The War Department recognizes that the burden placed on highway transportation as a result of troop movements in connection with mobilization and training maneuvers, requires the scheduling of convoy movements and the advance planning of maneuvers so as to incur a minimum of interference with civilian pursuits. That Department also realizes that maximum facility of movement, with the least interference to civilian activity, cannot be obtained without the cooperation of civilian authorities in the various States. To effectuate such cooperation, the Secretary of War has appointed a committee, designated as the Highway Traffic Advisory Committee to the War Department, composed of the heads of the national associations whose members will be directly concerned in three major problems:

1. Routing of troop and convoy movements
2. Provision of civilian driver records
3. Conduct of a nation-wide bus and truck inventory.

The first problem will enlist the aid of the State police, the Motor Vehicle Administrators and the highway departments, in assisting and routing convoy or other movements of military forces and equipment.

The second problem will require the assistance of the State Motor Vehicle Administrators in connection with the Army's driver training program.

The third problem will require the complete cooperation of the State Motor Vehicle Administrators, highway planning survey representatives of the Public Roads Administration, the War Department and the Work Projects Administration, in order to provide a complete list of truck and bus equipment which will be available for necessary emergency defense use.

It is intended that the national committee be a directing agency to coordinate the operation of similarly constituted subcommittees in the various States, appointed at the request of the Secretary of War, known as State Highway Traffic Advisory Committees and consisting of the Chief of State Police, who acts as liaison officer between the State committee, the Army and the national committee; the State Motor Vehicle Administrator; and the Commissioner or Chief Engineer of Highways. A series of recent meetings has resulted in the organization of the State committees into regional groups coextensive with the Army corps areas.

7. *Central Motor Transportation Committee.*

It was inevitable that the defense effort would develop the need of plans for the efficient and economical use of highways and motor vehicles, and require machinery for the determination of highway transportation needs, in order to assure an adequate supply of motor truck equipment. To meet these requirements and to advise on motor truck transportation problems, a Central Motor Transportation Committee was formed late in June by Mr. Ralph Budd, Transportation Commissioner, Office for Emergency Management.

The Central Committee is composed of the Interstate Commerce Commissioner in Charge of the Bureau of Motor Carriers as Chairman, the Commissioner of the Public Roads Administration, representatives of the Interstate Commerce Commission, Organized and Private Trucking Consultants to the Transportation Division, Office of Civilian Defense, National Grange and for-hire and private truck operators. The Central Committee has authority to establish such sub-committees as may be deemed necessary.

With the Central Committee are 16 regional committees with headquarters in the field offices of the

Motor Carrier Division of the Interstate Commerce Commission. Members represent the various types of carriers and include public members from the Highway Traffic Advisory Committee to the War Department and the Office of Civilian Defense.

Work of the Central Committee formed the basis for the issuance by OPM of a program to facilitate the acquisition of material for the production of trucks and passenger carriers. This program, based on estimated requirements for 1,189,000 trucks during the 1942 model year, includes a Limitation Order which gives specific instructions as to the number and kind of trucks and allied products which can be made during a specified period. Also included is a Limited Preference Rating Order which extends a rating of A-3 for use in obtaining material for truck production to the extent provided. This is a typical blanket rating order and is extendible by producers to their suppliers.

8. *Committee to investigate non-essential Federal expenditures.*

The Revenue Act of 1941 under Title VI, Section 601, established a committee to investigate Federal expenditures, to be composed of (1) three members of the Senate Committee on Finance and three members of the Senate Committee on Appropriations, to be appointed by the President of the Senate; (2) three members of the House Committee on Ways and Means and three members of the House Committee on Appropriations, to be appointed by the Speaker of the House of Representatives; and (3) the Secretary of the Treasury, and the Director of the Bureau of the Budget. The Committee is charged with the duty of making a full and complete investigation and report, to the President and to the Congress, of all expenditures of the Federal Government with a view to recommending the elimination or reduction of those deemed non-essential. The Committee is authorized to hold hearings, subpoena witnesses and take testimony and also to utilize the services, information, facilities, and personnel of the departments and agencies of the government.

The Public Roads Administration as the major Federal highway agency is prepared to cooperate fully with this committee to establish the requirements for adequate highway transport and for the construction of new facilities essential to the defense effort.

A comparison of the requirements for defense and civil vehicles in 1941 with those of 1940 clearly demonstrates the increased burden which defense activity has superimposed on the highway systems of the country.

From 1940 to 1941, military and civil requirements for new trucks and buses increased by 205,000 vehicles.

In the same period, the number of military and civil vehicles in service increased by more than 294,000 units.

It is estimated that military vehicles travelled nearly eleven times farther in 1941 than in 1940 and that the bulk share of this travel was added to an already heavy load due to the increase of civil traffic following on the defense effort.

Based on the best available evidence, it is estimated that the total 1941 carried load on rural highways approaches 72 billion ton-miles. This is approximately 24 per cent higher than the estimated total 1940 movement on rural highways.

A recent analysis of the distribution of average trip lengths of motor trucks operating on rural highways shows that 66.1 per cent of all trips are under 25 miles; 13.1 per cent are from 26 to 50 miles in length; 10.7 per cent are from 51 to 100 miles, and 10.1 per cent are over 101 miles. In view of the predominance of short trips by highway trucks as compared with the relatively longer trips involved in railroad haul, it appears that truck haul on the highways is essentially supplementary to, rather than competitive with, rail haul. It is highly possible that peak transport periods may produce a definite shortage of motor truck equipment.

Recent large increases in traffic volume and extensive defense migration of large numbers of persons into strange surroundings operate to make imperative the provision of maximum protection to highway traffic, particularly at railroad grade crossings. Recent progress in the evaluation of relative accident hazard at grade crossings permits of obtaining the maximum of aggregate hazard elimination with a given sum of money.

SUMMARY

From a consideration of the foregoing description of the current demands on highway transport and of the procedures established to deal with the problems presented, it should be self evident that:

1. Federal highway expenditures must be directed toward defense objectives and all other requirements must be subordinated thereto.

2. Highway administrative agencies, national, state and local, must be fully prepared to justify, as essential, the expenditures made for highway improvement.

What the Priorities System Is— And What It Is Not[1]

By DONALD M. NELSON

Executive Director, Supply Priorities and Allocations Board, Washington, D. C.

• With each passing day the priorities system becomes more and more important to a rapidly increasing number of business enterprises. And but a few steps behind priorities we are faced with the necessity of specific allocations with respect to many critical materials. A clear understanding of the situation should do much to enlist the sympathetic cooperation of those affected. In the following article Mr. Donald Nelson, Executive Director, Supply Priorities and Allocations Board, forthrightly discusses this problem and we believe his observations merit the close attention of crushed stone producers.

I WANT to talk to you frankly tonight about priorities.

I want to explain to you what the priorities system is—and what it is not. And I want you to understand why the system is necessary and what it does. If you get the answers to these questions I believe you will have a much better understanding of this defense program and of the national emergency itself.

First of all I want to talk about what the priorities system is *not*.

A Congressman called my office the other day to complain: "Mr. Nelson, your priorities system is raising hell with business in my district. It's got business all crippled".

To which I replied: "Mr. Congressman, it isn't priorities that is bothering business in your district It's shortages. There's a big difference".

It is that big difference that I would like to discuss first of all: that distinction between the shortage which causes the trouble and the priorities system which tries to alleviate the trouble.

These shortages are the key to nearly all of the dislocations which our economy is feeling as a result of this defense effort. Where do they come from?

In general terms, the answer is simple: they come from the tremendous effort we are making—from the fact that modern war takes everything you can possibly give it, from the hard, inescapable fact that this nation cannot possibly lay its hands on enough of the critical metals to meet all the needs of defense and at the same time meet all the wants of the civilian economy.

Before we look into the military needs in detail, let's take just a moment to consider the wants of our civilian economy. The tremendous sums which are being spent for defense are of course being translated into mass purchasing power. Right at the moment, our national spending power—that is, the spending power of our 130 millions of people, who are seeking to buy the things they as individuals need or desire—is undoubtedly greater than it has ever been before. That means that the demand for everything we make has gone up.

All by itself, that demand could furnish us with a vast business boom. People who have been on short rations for years have money to spend now; an enormous backlog of unsatisfied wants has been built up and is now looking for satisfaction.

If those wants could be filled without interfering with the defense effort, everything would be rosy. Unfortunately, they can't. The barrel only holds so much. We cannot under any circumstances find the materials to make all the things we need for defense, all the things that our civilian economy must have if it is to function properly, *and* all of the luxury and comfort items that people today want to buy. There just isn't that much in the barrel. We have to cut somewhere. The only place to do the cutting is in the area of things that we can get along without if we have to.

Modern war is a war of materials and of productive systems. That cannot be said too often. The day when you could be secure if you raised a mass army, put rifles in the army's hands, and taught it how to march and shoot, are gone forever. Today's army cannot be any better than its equipment—plus the ability of the people back home to replace that equipment in adequate volume. And today's equipment is fearfully complex. It calls for such metals as aluminum in incalculably greater quantity than any normal peace-time use. It eats up that basic metal, steel, with an insatiable appetite. It uses copper in such volume that this country, which

[1]Address before a meeting of the New York Sales Executives Club, at the Hotel Roosevelt, New York, October 14, 1941.

has always had abundant supplies of that metal, cannot in the current month make its total production plus its total imports equal the total of Army and Navy orders.

It might be a good thing to examine that copper picture more closely for a moment.

During 1942, our military requirements for copper will run to at least one million tons. I use that word "requirements" advisedly; I mean by that that our Army and Navy *must* have that much copper for articles that we *must* have for defense. In addition, it will take at least 550,000 tons of copper for the maintenance and necessary expansion of those power, transportation, communication and other services which simply have to be maintained if our economy is not to collapse utterly. Thus during the coming year we start with the knowledge that slightly more than one and one-half million tons of copper are absolutely needed for direct defense purposes and for civilian uses which cannot possibly be pared down. In other words, when we do our figuring on copper for next year we have to start by putting our hand in the basket and taking out of circulation one and one-half million tons.

Now the total supply of copper that is going to be available during 1942 is, by the maximum estimate, 1,800,000 tons. That includes all of the copper we can produce in the United States, plus all that we shall be able to import, plus all that we can reclaim through the remelting of scrap copper. As a matter of fact it is probable that we won't actually get the 1,800,000 tons; mining is subject to various hazards, and shipping shortages and submarine warfare might easily reduce the amount which we expect to import. Nevertheless, let's take the rosiest view possible and assume that we shall have 1,800,000 tons of copper in our national basket for 1942.

We have already seen that right off the bat we must reach into that basket and take out one and one-half million tons. We have left, therefore, slightly less than 300,000 tons of copper for ordinary civilian uses.

Yet those "ordinary civilian uses"—by which I mean *all* normal uses of copper except those involved in maintaining our transportation, communication and defense manufacturing industries at the necessary level—would run to more than one million tons, if everybody got what he needed. And to meet that million-ton demand, our basket holds rather less than 300,000 tons.

I want to emphasize again that those figures, bad as they are, represent the most optimistic view possible. We can't possibly increase our supply above that level of 1,800,000 tons, and we may very well fall substantially short of that mark. And the figure for military requirements is a minimum figure which cannot be lowered but may easily be raised. It does not, for example, make any allowance for the copper we should need if we got into a shooting war; it does not allow for any possible expansion of our Army.

The situation in regard to copper, then, is probably worse than the figures show rather than better. But even assuming that it is not, it is perfectly obvious that for all ordinary civilian uses of copper the demand exceeds the supply by more than three to one. We are very clearly in a spot where we cannot afford to use one pound of copper if we can possibly get along without it. More than two-thirds of all ordinary demands for copper are going to be disappointed no matter what we do.

When you have a situation as acute as that, the very worst thing you could do would be to do nothing at all. If we had no priority controls—if the Government did not step in to say that the essential demand for copper should have precedence over the non-essential demand—no user of copper would be in the slightest degree better off than he is now. On the contrary, he would be much worse off. He would still face that better than three-to-one demand for every pound of copper on the market, and there would be no order or sanity whatever to the way in which that demand was met.

It ought to be clear, then, that you cannot possibly have business as usual in the face of that kind of a shortage. You have to have controls, you have to have rationing, you have to have planned, forceful Government action which will say, in effect: "There is not nearly enough copper to go around, and we are living in a time of great emergency: consequently, the Government must see to it that no copper is used by anyone unless the job that person is doing is one which is essential in one way or another to the country's welfare".

That is precisely what the Government is doing now. There is now being drafted an order sharply curtailing innumerable uses of copper. For the rest of the emergency, for example, no one will be allowed to make such things as vases, pitchers, candlesticks, andirons, cuspidors, ashtrays and doorknobs containing copper. You will not, after the first of the year, be able to buy copper stripping or screening for your house; if you die you can't be buried in a

bronze casket, and your family will not be able to put up a bronze memorial marker in your memory.

It isn't pleasant to issue orders like that. They aren't being issued just for the fun of it. And—which is the big point—it isn't the order itself that is the cause of the trouble; it's the shortage, which is what makes the order necessary.

Turn next to steel. We have the greatest steel-producing capacity of any country on earth. Our mines, blast furnaces, our fabricating plants—they are adequate to produce steel to meet any conceivable need . . . or so, at any rate, we had always supposed.

But are they, really? Look at the figures. Steel ingot productive capacity today for the nation as a whole is 86,000,000 tons. Construction of new facilities now under way will raise that capacity to 89,000,000 tons by the end of 1942.

During 1942, the best estimates we can get show that for defense—for our Army and Navy, plus the things we must send abroad under the Lend-Lease Act—we must have more than 35 million tons. Thirty-five from 89 equals 54: offhand, one might think that would be ample to carry us through the year. Yet our civilian economy would, if there were no restrictions at all, consume 86 million tons of steel during the year. It can't possibly get what it wants, because we have to subtract 35 million tons from the total of 89 million tons which will be produced; but when what appear to be all of the less essential requirements have been thrown out, we still find our civilian economy needing 58 and one-half million tons during the year. And that, added to the 35-odd million tons needed for defense, brings our total national need—our *need*, not what we would use if there were no restrictions—up to nearly 94 million tons, which is about five million tons more than there is going to be.

You can't work out arithmetic problems like that and not get a shortage. To sum it up: in steel you get a five million ton shortage even when you have pared your civilian requirements down to what looks like the essentials.

Copper and steel: those are just two of our basic metals. They are fair samples of the rest. What is happening to them is happening to the others. There simply is not enough to go around.

Now it must be obvious that what is troubling industry in regard to steel and in regard to copper isn't priorities at all. It's shortages. No industrialist is going without copper or steel *because* they are under priority control; the exact opposite is true—they are under priority control because he has to go without them. Priority control is the one thing that keeps a shortage such as the one in copper from bringing absolute chaos and utter disorganization to industry.

Think it over for a moment. We've got that copper shortage because we are trying to lick Hitler, not because we have a Division of Priorities in OPM. Take away all of the priorities controls and we'd still have the shortage. And how would the shortage be met? By the maddest, cruellest, most destructive industrial scramble you ever heard of in your life. There is no power on earth that would keep prices from going right up through the roof. The copper would wind up in the hands of those whose jobs is most important to the country. A gadget-maker might be turning out copper ashtrays and brass andirons while a shell factory stood idle for lack of electric power transmission lines. Chaos is by no means too strong a word to describe the state of things that would inevitably follow.

Under such a situation, the little man would have no chance whatever. He would have neither the financial resources nor the organization to fight for his fair share. He would be licked before he started. Only through some system of priority control does he have the slightest chance of getting what he needs. Obviously, the priorities system helps him much more than it hurts him.

Priority control, then, is simply a means of averting chaos. It is a means of putting first things first; a traffic cop, so to speak, with the job of directing traffic in critical materials in such a way that they land where the national need for them is greatest. It isn't an easy job or a pleasant one—nobody ever loves a traffic cop, and I personally have a more acute sympathy today for the man in the blue uniform than I ever expected to have in my life. But it is a vitally necessary job.

Last week the Supply Priorities and Allocations Board laid down the broad policy that during the rest of this emergency priorities ratings will not be granted on any materials used in the construction field unless the job for which they are needed is either directly necessary for national defense or essential to the health and safety of the people of the nation. That was a drastic thing to do; a hard thing to do. Yet it simply had to be done. You have just reviewed those figures on steel and copper. Surely they make it obvious that we cannot afford to use steel or copper in any construction job that can possibly be postponed. There are factories today which

stand idle because they cannot get any copper: would it be fair to let those factories stand idle for that reason while the copper which might have kept them alive is used, say, to help build a new postoffice right across the street? The situation being what it is, would it make anything resembling sense to close a man's shop with one hand and with the other to build a 50-mile electric transmission line to serve a summer resort colony that is inhabited only three months in the year?

It isn't just a case of "somebody has to go without"; it's a case of *everybody* has to go without, unless the job he is doing is so important to the nation —to the nation, not just to him—that we dare not let it go undone. What is true in the field of construction is true of all other fields of activity. If we can get along without something we have got to get along without it.

Now, to repeat, it is not priorities that is doing all of this. It is shortages; it is war; it is the terrible thing we are up against if we wish to remain free men.

We must do other things than issue priority ratings in order to solve the problems which shortages bring. We must find some means of adjusting our lives and our economy to this defense effort. We need every pound of material, every man and every machine that we can possibly spare; we must now go beyond priorities action in order to see to it that providing the necessary materials for defense does not involve letting the man and the machine go idle. That can be done and it will be done. It isn't easy and it can't be done as quickly as we would all wish, but it will be done.

I don't suppose I need to remark that none of us like these shortages. I don't like them and you don't like them. But they are a part of the war; until Hitler is licked we are going to have them, like them or not. And because we don't like them I would like to pose a question to you and to all the rest of America:

Which would you prefer: to put up with shortages such as we have had so far for year after year—ten years, fifteen years, perhaps longer—or to put up with some really terrific shortages for one or two years and get the job over quickly?

I don't think there is much doubt about the answer. I think the temper of the American people, facing this kind of job, is to make the biggest effort possible and get the thing done no matter how much it hurts. I think we would rather bear the hardship for a short time than having this tremendous urgency, and the fear of the loss of our freedom, hanging over us for a long time.

Therefore I think we ought to realize that our best and quickest way out of the trouble we are in is to plunge straight ahead and double everything we have done. Are we short of copper and steel and aluminum and so on? Okay: let's make our military demands for those things twice as great as they are now and go *really* short of them, and get this nightmare over with. In other words, let's shoot the works. Hitler can be beaten; we have said that he is going to be beaten; and he can be beaten over a long pull or over a short pull. We don't want to go on living under priority controls for another half-generation. The way to avoid it is to go all-out now and finish it quickly.

That involves several things. It involves setting our sights much higher than we have ever set them before. It involves the imagination and the daring that enable a people to tackle a job bigger than their dreams. Roughly, you might say it involves figuring out the utmost we can do—and then resolving to go ahead and do twice as much.

It involves another thing, too. It calls for a different sort of attitude toward the adjustments which we have to make because of these shortages. Right now, for example, all of us realize that one of our greatest problems is how to save business—and labor, and the consumer, and everyone else—from the cruel effect of these shortages. Why can't we muster the imagination to say: Our biggest problem is not how to *save* business and labor and John Citizen, but rather how to *use* them? The job ahead of us is so big that we can't have any unemployment in it; we can't have any idle factories or machines; we can't have one bit of muscle that isn't at work. We can save ourselves by using ourselves. If we jump into the job hard enough and fast enough, we solve half of its problems. The one thing we cannot do is drag along, going just fast enough to wear ourselves out but not quite fast enough to win.

I believe that the people of this country have the daring, the will and the imagination to tackle the job in that way. We know what is at stake—our lives as free men, our right to do and to hope and to dream, our chance for the only kind of happiness that Americans care for. Those things are worth everything to us. They are worth more than money or privileges or life itself; they are our world, and we propose to keep them. And if we live up to the American ideal, we shall keep them—and keep the ideal with them.

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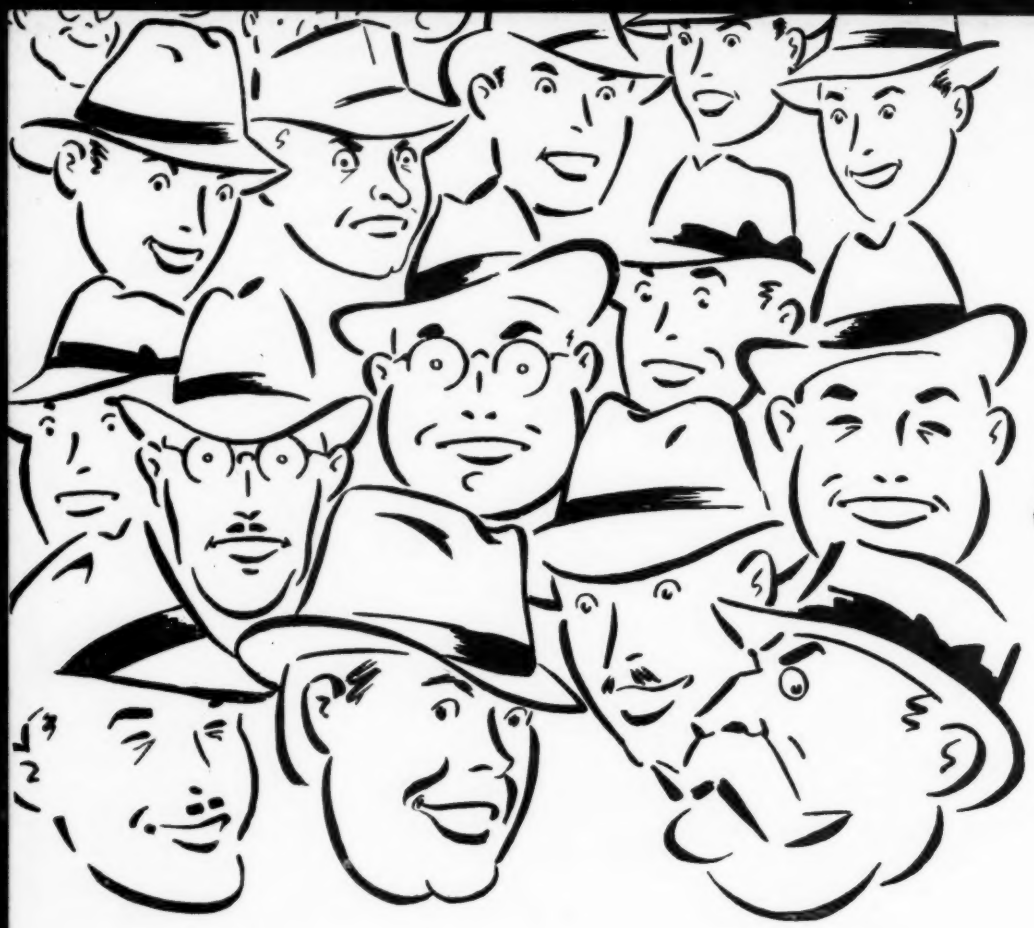

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